We claim:

1. A DC-DC converter for use with a DC power source having a DC voltage across a first voltage source output and a second voltage source output and with a load, the converter comprising:

a. an input for accepting the DC voltage, the input having a first voltage input and a second voltage input,

b. an output for outputting a converted DC voltage, the output having a first voltage output and a second voltage output,

c. a high side circuit including a first primary winding of a first transformer and an auxiliary section, the high side circuit connected between the first voltage input and the first voltage output,

d. a rectifier circuit having a first secondary winding of the first transformer, the rectifier circuit connected between the first voltage output and the second voltage output, and

e. an output capacitor connected between the first voltage output and the second voltage output and across the rectifier circuit,

wherein an output converter DC voltage between the first voltage output and the second voltage output has the same polarity as a DC voltage input between the first voltage input and the second voltage input,

wherein the auxiliary section is for causing the first transformer to transfer power from the first primary winding to the first secondary winding and to operate without saturation,

wherein the high side circuit has a high side circuit output connected such that current flowing through the first primary winding is directed between the high side circuit output and the first voltage output,

wherein the rectifier circuit is for converting output of the first secondary winding into a one-direction waveform and converting the one-direction waveform into a DC voltage, and

wherein the output capacitor is for filtering the converted DC voltage.

2. The converter of claim 1, wherein the auxiliary section comprises switches for repeatedly connecting and disconnecting the primary winding from the input, and allows for resetting of the first transformer.

3. The converter of claim 2, wherein the auxiliary section comprises a combination of switches and capacitors.

4. The converter of claim 1, wherein the auxiliary section comprises four switches.

5. The converter of claim 4, wherein each switch is a MOSFET.

6. The converter of claim 1, wherein the auxiliary section comprises a first switch connected between a first side of the first primary winding and the first voltage input , a second switch connected between a second side of the first primary winding and the first voltage input , a third switch connected between the first side of the first primary winding and the high side circuit output, and a fourth switch connected between the second side of the first primary winding and the high side circuit output.

7. The converter of claim 6, wherein each switch has an input for a gate drive signal for controlling the operation of the switch.

8. The converter of claim 7, wherein the gate drive signals repeatedly turn on and turn off the first and fourth switch, as well as turn on and off the second and third switch.

9. The converter of claim 1, wherein the auxiliary section comprises a first switch connected between a first side of the first primary winding and the first voltage input , a first capacitor connected between a second side of the first primary winding and the first voltage input , a second switch connected between the first side of the first primary winding and the high side circuit output, and a second capacitor connected between the second side of the first primary winding and the high side circuit output.

10. The converter of claim 9, wherein each switch has an input for a gate drive signal for controlling the operation of the switch.

11. The converter of claim 10, further comprising gate drive signals adapted to repeatedly turn on and turn off the first switch and the second switch, whereby the first transformer can be reset from the capacitors.

12. The converter of claim 10, wherein the capacitors are large enough that the voltage across the capacitors will not change significantly during normal operation of the converter.

13. The converter of claim 1, wherein the auxiliary section comprises a first switch connected between a first side of the first primary winding and the first voltage input , a first diode connected between a second side of the first primary winding and the first voltage input for forward conduction from the second side of the first primary winding to the first voltage input, a second switch connected between the second side of the first primary winding and the high side circuit output, and a second diode connected between the first side of the first primary winding and the high side circuit output for forward conduction from the high side circuit output to the first side of the first primary winding.

14. The converter of claim 13, wherein each switch has an input for a gate drive signal for controlling the operation of the switch.

15. The converter of claim 14, further comprising gate drive signals adapted to repeatedly turn on and turn off the first switch and the second switch, whereby the first transformer can be reset by current flowing through the first and second diodes.

16. The converter of claim 1, wherein the auxiliary section comprises a first side of the first primary winding connected to the first voltage input , a first switch connected between the first side of the first primary winding and the first side of the first capacitor, the second side of the first capacitor connected to the second side of the first primary winding, a second switch connected between the second side of the first primary winding and the high side circuit output.

17. The converter of claim 16, wherein each switch has an input for a gate drive signal for controlling the operation of the switch.

18. The converter of claim 17, further comprising gate drive signals adapted to repeatedly turn on the first switch, while turning off the second switch, and turn off the first switch, while turning on the second switch, whereby the first transformer can be reset from the first capacitor.

19. The converter of claim 1, wherein the rectifier circuit further comprises a combination of inductors and switches, wherein the switches are for converting alternating voltage in the

first secondary winding into pulsating one-direction voltage and the inductors are for converting pulsating one-direction voltage into DC voltage.

20. The converter of claim 1, wherein the rectifier circuit further comprises a combination of inductors and diodes, wherein the diodes are for converting pulsating alternating voltage in the first secondary winding into pulsating one-direction voltage and the inductors are for converting pulsating one-direction voltage into DC voltage.

21. The converter of claim 1, wherein the rectifier circuit further comprises a first rectifier switch connected between the second voltage output and a first side of the first secondary winding, a second rectifier switch connected between a second side of the first secondary winding and the second voltage output, a first inductor connected between the first side of the first secondary winding and the first voltage output, and a second inductor connected between the second side of the first secondary winding and the first voltage output.

22. The converter of claim 21, wherein each switch has an input for a gate drive signal for controlling the operation of the switch.

23. The converter of claim 22, further comprising gate drive signals adapted to switch the first and second rectifier switches to convert bi-directional AC voltage at the first secondary winding into one-direction pulsating voltage.

24. The converter of claim 1, wherein the rectifier circuit further comprises a first rectifier switch connected between the second voltage output and a first side of the first secondary winding, a second rectifier switch connected between a second side of the first secondary winding and the second voltage output, and a first inductor connected between the first side of the first secondary winding and the first voltage output not in series with the second rectifier switch.

25. The converter of claim 1, wherein the rectifier circuit further comprises first and second rectifier diodes and a first inductor, wherein the first diode is connected between a first side of the first secondary winding and the first inductor, and the inductor is further connected between the first diode and the first voltage output, for forward conduction from the secondary winding through the inductor, and the second diode is connected between (a) a point between the second side of the first secondary winding and the

second voltage output and (b) a point between the first inductor and first diode, also for forward conduction from the secondary winding through the inductor.

26. The converter of claim 1, wherein the rectifier circuit further comprises a second secondary winding, first and second rectifier diodes and a first inductor, wherein a second side of the first secondary winding is connected to a first side of the second secondary winding and the second voltage output, and the first diode is connected between a first side of the first secondary winding and the first inductor, and the inductor is further connected between the first diode and the first voltage output, for forward conduction from the secondary winding through the inductor, and the second diode is connected between the second side of the second secondary winding and a point between the first inductor and first diode, also for forward conduction from the secondary winding through the inductor.

27. The converter of claim 1, wherein the rectifier circuit further comprises a second secondary winding, first and second rectifier switches and a first inductor, wherein a second side of the first secondary winding is connected to a first side of the second secondary winding and the inductor which is further connected to the first voltage output, and the first rectifier switch is connected between a first side of the first secondary winding and the second voltage output, and the second rectifier switch is connected between a second side of the second secondary winding and the second voltage output.

28. The converter of claim 21, wherein the first and second rectifier switches, the first secondary winding and the first and second inductors are comprised within a first rectifier section, and the rectifier circuit further comprises a second rectifier section similar to the first rectifier section, and the first and second rectifier sections are connected in parallel with one another and with the output capacitor and the output.

29. The converter of claim 26, wherein the first and second diodes, the first secondary and second secondary windings and the inductor are comprised within a first rectifier section, and the rectifier circuit further comprises a second rectifier section similar to the first rectifier section, and the first and second rectifier sections are connected in parallel with one another and with the output capacitor and the output.

30. The converter of claim 27, wherein the first and second rectifier switches, the first secondary and second secondary windings and the inductor are comprised within a first

rectifier section, and the rectifier circuit further comprises a second rectifier section similar to the first rectifier section, and the first and second rectifier sections are connected in parallel with one another and with the output capacitor and the output.

31. The converter of claim 1, further comprising a second converter similar to the converter of claim 1, wherein the two converters are connected in parallel with one another at their respective inputs and outputs.

32. The converter of claim 31, wherein the output capacitors of the two converters are combined as a single physical capacitor.

33. The converter of claim 31, wherein the two converters have inputs for interleaved gate drive signals, whereby voltage ripple incoming to the output capacitor is reduced, allowing for reduction in the size of the output capacitor.

34. The converter of claim 1, further comprising a second transformer and wherein the high side circuit further comprises a second primary winding of the second transformer, and first and second second primary switches, wherein the first second primary switch is connected between the first voltage input and a first side of the second primary winding, and the second second primary switch is connected between the first side of the second primary winding and the first voltage output, and a second side of the second primary winding is connected to a side of the first primary winding, and wherein the rectifier circuit comprises a second rectifier circuit similar to and connected in parallel with the first rectifier circuit, wherein the second rectifier circuit includes a second second rectifier secondary of the second transformer.

35. The converter of claim 34, wherein the second primary switches have inputs for gate drive signals for operating the second primary winding out of phase with the first primary winding.

36. The converter of claim 1, further comprising a second transformer and wherein the high side circuit further comprises a second primary winding of the second transformer, and first and second second primary switches, wherein the first second primary switch is connected between the first voltage input and a first side of the second primary winding, and the second second primary switch is connected between the first side of the second primary winding and the high side circuit output, and a second side of the second primary winding is connected to a side of the first primary winding, and wherein the

rectifier circuit comprises a second rectifier secondary winding, a second rectifier inductor and a second rectifier switch, wherein a first side of the second rectifier secondary winding is connected to a first side of the first secondary winding and the second rectifier switch is connected between a second side of the second secondary winding and the second voltage output, and the inductor is connected between the second side of the second secondary winding and the high side circuit output, not in series with the second rectifier switch.

37. The converter of claim 36, wherein the second primary switches have inputs for gate drive signals for operating the second primary winding out of phase with the first primary winding, and the first and second rectifier circuits have inputs for gate drive signals for operating the rectifier circuit secondary windings phase shifted from one another.

38. The converter of claim 1, further comprising a second transformer and a third transformer, wherein the high side circuit further comprises a second primary winding of the second transformer, and first and second second primary switches, and wherein the first second primary switch is connected between the first voltage input and a first side of the second primary winding, and the second second primary switch is connected between the first side of the second primary winding and the high side circuit output, and a second side of the second primary winding is connected to a side of the first primary winding, and wherein the rectifier circuit comprises a second rectifier circuit and a third rectifier circuit each similar to and connected in parallel with the first rectifier circuit, wherein the second rectifier circuit includes a second second rectifier secondary of the second transformer and the third rectifier circuit includes a third third rectifier secondary of the third transformer.

39. The converter of claim 38, wherein the second primary switches have inputs for gate drive signals for operating the second primary winding out of phase with the first primary winding, and no additional drive components are added for the third primary winding, wherein the converter has gate drive inputs for operating the third primary winding partially in phase with the first primary winding and partially in phase with the second primary winding.

40. The converter of claim 1, wherein the first voltage input is for accepting a DC potential that is positive when compared to a DC potential for acceptance by the second voltage input.

41. The converter of claim 40, wherein the DC potential of the first voltage output is positive when compared to the DC potential of the second voltage output.

42. The converter of claim 1, wherein the input voltage is within a range of 10.8 volts DC to 13.2 volts DC, and the out put voltage is within a range of 0.8 volts DC to 1.6 volts DC.

43. The converter of claim 1, wherein the duty cycle is between 40% and 60%.

44. The converter of claim 1, wherein the duty cycle is approximately 50%.

45. The converter of claim 31, wherein the duty cycle of each of the first and second converters is between 40% and 60%.

46. The converter of claim 31, wherein the duty cycle of each of the first and second converters is approximately 50%.

47. The converter of claim 38, wherein the duty cycle of each of the first, second and third transformers is approximately 33-1/3%.

48. The converter of claim 1, further comprising a second high side circuit similar to the first high side circuit, connected in parallel with the first high side circuit, and a second rectifier circuit connected in parallel with the first rectifier circuit.

49. The converter of claim 48, further comprising inputs for drive signals to operate the first high side circuit and the first rectifier circuit out of phase with the second high side circuit and the second rectifier circuit, respectively.

50. The converter of claim 48, further comprising gate drive signals for operating the first high side circuit and the first rectifier circuit out of phase with the second high side circuit and the second rectifier circuit, respectively.

51. The converter of claim 1, further comprising a current sensor in series with the high side circuit.

52. The converter of claim 51, wherein current sensed at the current sensor is for use in determining the timing of gate drive signals for operating the high side circuit.

53. The converter of claim 1, wherein the output of the first secondary winding is a pulsating voltage and the one-direction waveform is a one-direction voltage.

54. The converter of claim 1, wherein the high side circuit further comprises a resonant tank.

55. The converter of claim 54, wherein the resonant tank comprises a first capacitor in parallel with the first primary winding and a first inductor in series with the first primary winding between the first primary winding and the auxiliary circuit.

56. The converter of claim 55, wherein the resonant tank further comprises a second capacitor in series with the first inductor between the first primary circuit and the auxiliary circuit.

57. The converter of claim 56, wherein the resonant tank further comprises a second inductor in parallel with the first primary winding and the first capacitor.

58. The converter of claim 54, wherein the resonant tank comprises a first inductor and a first capacitor in series with one another between the first primary winding and the auxiliary circuit.

59. The converter of claim 54, wherein the rectifier circuit comprises a full-bridge rectifier.

60. The converter of claim 54, wherein the rectifier circuit comprises a half-bridge rectifier.

61. The converter of claim 54, comprising switches that are controlled by switching frequency control to regulate the output voltage.

62. The converter of claim 54, wherein the auxiliary section is a full-bridge auxiliary section.

63. The converter of claim 62, wherein switches within the auxiliary section are controlled by phase shift control.

64. The converter of claim 59, wherein switches within the rectifier circuit are controlled by phase control.

65. A method of operating a DC-DC converter for use with a DC power source having a DC voltage across a first voltage source output and a second voltage source output and with a load, the converter comprising:

a. an input for accepting the DC voltage, the input having a first voltage input and a second voltage input,

b. an output for outputting a converter DC voltage, the output having a first voltage output and a second voltage output,

c. a high side circuit including a first primary winding of a first transformer and an auxiliary section, the high side circuit connected between the first voltage input and the second voltage output,

d. a rectifier circuit having a first secondary winding of the first transformer, the rectifier circuit connected between the first voltage output and the second voltage output, and

e. an output capacitor connected between the first voltage output and the second voltage output and across the rectifier circuit,

wherein an output converter DC voltage between the first voltage output and the second voltage output has the same polarity as a DC voltage input between the first voltage input and the second voltage input,

wherein the auxiliary section is for causing the first transformer to transfer power from the first primary winding to the first secondary winding and to operate without saturation,

wherein the high side circuit has a high side circuit output connected such that current flowing through the first primary winding is directed between the high side circuit output and the first voltage output,

wherein the rectifier circuit is for converting output of the first secondary winding into a one-direction waveform and converting the one-direction waveform into a DC voltage, and

wherein the output capacitor is for filtering the converted DC voltage,

the method comprising the steps of:

driving the auxiliary section to cause the first transformer to transfer power from the first primary winding to the first secondary winding,

while at the same time driving the auxiliary section to cause the transformer to operate without saturation.